Hydrological Summary
for the United Kingdom

August 2017

General
August was, for the most part, decidedly autumnal with cool temperatures and unsettled wet weather, until a glimpse of summer in the final week when August Bank Holiday Monday was the warmest on record (since it was introduced in 1965). Rainfall was generally persistent and showery, although in western parts of Northern Ireland intense thunderstorm activity triggered highly disruptive flash flooding and generated new period of record peak flows. Whilst north-east England and south Wales were notably dry, Scotland, Northern Ireland and south-east England bore the brunt of the rainfall. Despite the wet weather, August was the driest of the last three months, concluding a summer which ranks amongst the top 10 wettest on record for the UK (in a series from 1910). Soil moisture deficits (SMDs) generally increased in August, though soils mostly remained wetter than average. August river flows were generally above normal in the west of the UK and near or above average in southern and eastern Britain, though flows in some less responsive catchments of southern and central England were notably or exceptionally low for the time of year. Reservoir stocks generally increased in the north and west of the UK and were substantially above average across northern Britain and Northern Ireland. Though some groundwater levels in the Chalk rebounded slightly relative to average, levels remained below normal or notably low across much of south-east England, suggesting that recharge will commence from a below normal baseline. As such, autumn and winter rainfall will have a pivotal role in determining the onset and magnitude of recharge, which in turn will be influential on the water resource outlook for 2018.

Rainfall
A southward migration of the jet stream through late July and the first half of August propelled a series of depressions across the UK. Westerly and north-westerly airflows brought cool temperatures and unsettled weather through much of the first three weeks, before a warm and dry interlude towards month-end. Wet weather on the 8th/9th (e.g. 54mm at Leconfield, Humberside and 45mm at Kenley, south London) triggered flash flooding and disrupted travel on a number of motorways. Most notably, on the 22nd/23rd intense convective storms in the north of the island of Ireland delivered 62mm rainfall at Lough Fea, though radar estimates suggest up to 80-100mm fell in 12 hours. More than 120 people were rescued from buildings and cars, roads became impassable, and landslides and power cuts caused severe disruption. Flash flooding from thunderstorms on the 23rd in North and West Yorkshire and around Dundee also impacted road and rail networks. For August overall, the spatial pattern of rainfall anomalies was patchy, owing to the convective nature of the events that delivered most of the substantial daily totals. Whilst parts of Northern Ireland, Scotland, Humberside, Cornwall and the far south-east of England registered more than 130% of the long-term average, large areas of Northumberland, south Wales, Wessex and Norfolk recorded less than 90%. Summer (June-August) rainfall was above average for the majority of the UK with the exception of the Midlands. More than 150% of average was registered in a band from south-west to north-east Scotland, and it was the fifth wettest summer on record for Scotland (in a series from 1910). Despite the wet summer, 12-month rainfall accumulations remain around 90% of the long-term average at the national scale.

River flows
In general, persistent rainfall through the first three weeks of August generated only moderate hydrological responses, with a few notable exceptions. Thunderstorms in south-east England on the 8th/9th generated daily mean flows amongst the highest recorded in August on the Colne, Blackwater and Mole. The intense rainfall which fell across western parts of Northern Ireland on the 22nd/23rd triggered new peak flow maxima for any month on the Faughan and Mourne, in series from 1976 and 1982, respectively. High flows on the Faughan destroyed the gauging station structure and deposited it in the channel, suggesting that both the event peak and daily mean flows are underestimated. Substantial volumes of water damaged and collapsed a number of bridges, isolating communities and hampering recovery work. Mean flows for August were above normal across most of the north and west of the UK, notably so in parts of Northern Ireland, Scotland, west Wales and Cornwall, where the Mourne, Earn, Cree, Teifi and Warleggan recorded more than twice their monthly average flow. Further south and east flows were notably high in the Colne and Blackwater but remained notably or exceptionally low for the Soar and Coln. New late August daily flow minima were recorded on the Soar. Summer average flows were above normal in northern Britain, notably so in catchments draining western Scotland and parts of northern England and north Wales. Across the English Lowlands, flows were mostly within or below the normal range, and exceptionally low in the Coln which registered half its average summer flow and ranked second lowest on record behind only the 1976 drought.

Groundwater
SMDs were near normal for the time of year across the major aquifer areas of southern and eastern England, though soils were drier than average in the Midlands. In the Chalk, groundwater levels generally fell, but a small rise was recorded at Westdean No.3, and larger ones at Killyglen and at West Woodyates Manor where levels have respectively remained, and risen to, above average. Across East Anglia and southern England, levels remained notably low at most sites, but less so than earlier in the summer. Levels in the more rapidly responding Jurassic and Magnesian limestones fell and remained within the normal range. In the Permo-Triassic sandstones, groundwater levels also fell, and remained notably low at Llanfair DC. However, a small rise at Newbridge produced a record high level for the third consecutive month. Levels in the Carboniferous Limestone in south Wales rose overall during August and were in the normal range. Despite levels in the Fell Sandstone falling, at Royalty Observatory they were notably high for the time of year.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1981-2010 average.

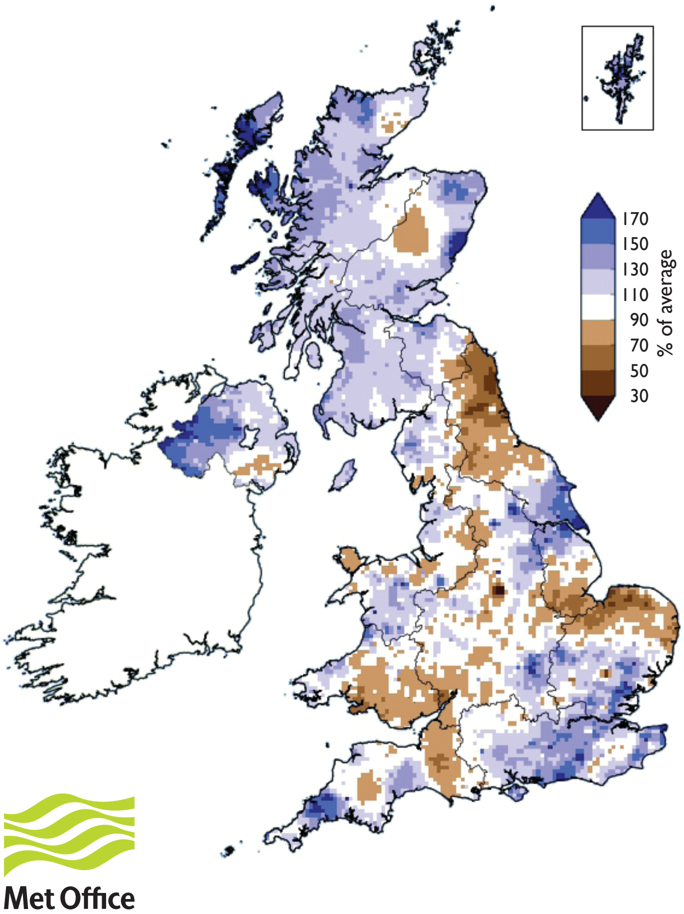
Region	Rainfall	Aug 2017	Jun17 – Aug17	RP	Mar17 – Aug17	RP	Dec16 – Aug17	RP	Sep16 – Aug17	RP
United	mm	**104**	325		517		764		1013	
Kingdom	%	**120**	139	10-20	111	5-10	97	2-5	90	2-5
England	mm	**75**	255		403		564		763	
	%	**110**	134	5-10	109	2-5	94	2-5	90	2-5
Scotland	mm	**145**	419		664		1046		1370	
	%	**130**	145	30-50	112	5-10	99	2-5	90	2-5
Wales	mm	**123**	387		650		952		1251	
	%	**119**	140	5-10	116	5-10	97	2-5	88	2-5
Northern	mm	**125**	357		555		761		986	
Ireland	%	**128**	140	10-15	111	5-10	94	2-5	87	5-10
England &	mm	**81**	273		437		618		830	
Wales	%	**112**	135	5-10	110	2-5	95	2-5	90	2-5
North West	mm	**113**	391		610		863		1133	
	%	**112**	146	8-12	120	5-10	101	2-5	92	2-5
Northumbria	mm	**62**	300		450		622		842	
	%	**84**	144	5-10	115	2-5	99	2-5	97	2-5
Severn-Trent	mm	**71**	216		360		512		688	
	%	**109**	115	2-5	100	2-5	91	2-5	88	2-5
Yorkshire	mm	**84**	293		433		589		790	
	%	**117**	146	8-12	114	2-5	97	2-5	94	2-5
Anglian	mm	**61**	205		323		434		586	
	%	**106**	125	5-10	107	2-5	97	2-5	94	2-5
Thames	mm	**69**	213		334		471		645	
	%	**122**	134	2-5	105	2-5	93	2-5	90	2-5
Southern	mm	**76**	234		355		513		688	
	%	**135**	150	5-10	111	2-5	94	2-5	86	2-5
Wessex	mm	**63**	233		380		552		771	
	%	**98**	131	2-5	105	2-5	89	2-5	87	2-5
South West	mm	**94**	308		518		742		1030	
	%	**114**	133	5-10	108	2-5	86	2-5	84	5-10
Welsh	mm	**116**	371		625		914		1205	
	%	**115**	138	5-10	115	2-5	97	2-5	88	2-5
Highland	mm	**166**	436		744		1215		1578	
	%	**135**	138	15-25	110	5-10	97	2-5	87	2-5
North East	mm	**96**	314		473		693		924	
	%	**120**	141	5-10	109	2-5	99	2-5	91	2-5
Tay	mm	**116**	369		549		865		1137	
	%	**121**	145	8-12	104	2-5	92	2-5	85	5-10
Forth	mm	**118**	404		566		843		1078	
	%	**126**	160	20-35	115	5-10	99	2-5	89	2-5
Tweed	mm	**102**	357		534		768		1012	
	%	**122**	154	10-20	121	5-10	105	2-5	99	2-5
Solway	mm	**147**	496		751		1109		1404	
	%	**124**	165	30-50	125	20-30	107	5-10	94	2-5
Clyde	mm	**178**	513		791		1263		1672	
	%	**126**	145	30-50	112	5-10	100	2-5	92	2-5

% = percentage of 1981-2010 average *RP = Return period*

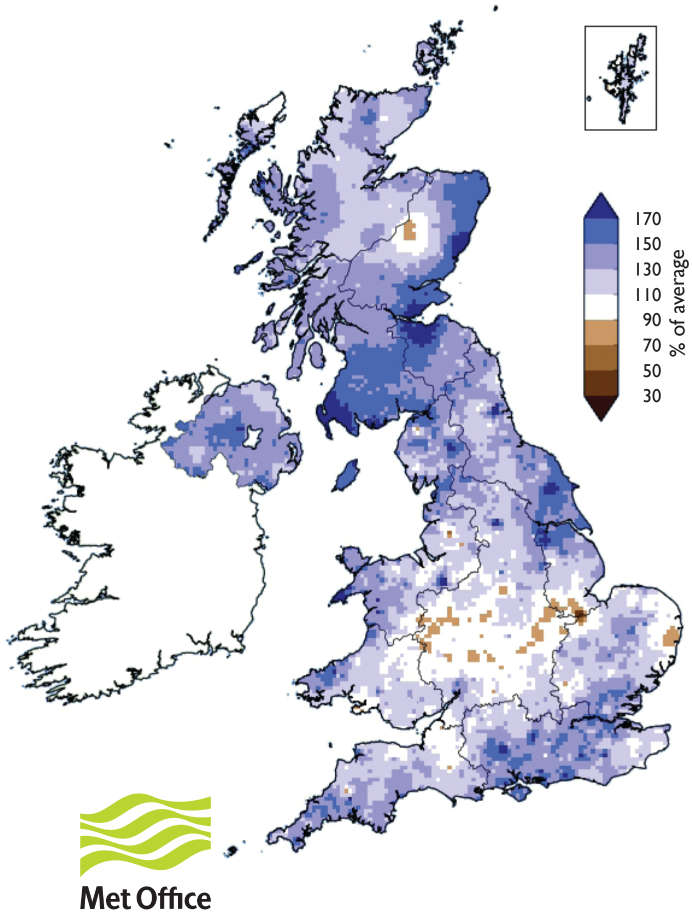
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1910; they also assume a stable climate. The quoted RPs relate to the specific timespans only; for the same timespans, but beginning in any month the RPs would be substantially shorter. The timespans featured do not purport to represent the critical periods for any particular water resource management zone. For hydrological or water resources assessments of drought severity, river flows and/or groundwater levels normally provide a better guide than return periods based on regional rainfall totals. Note that precipitation totals in winter months may be underestimated due to snowfall undercatch. All monthly rainfall totals since January 2017 are provisional.

Rainfall . . . Rainfall . . .

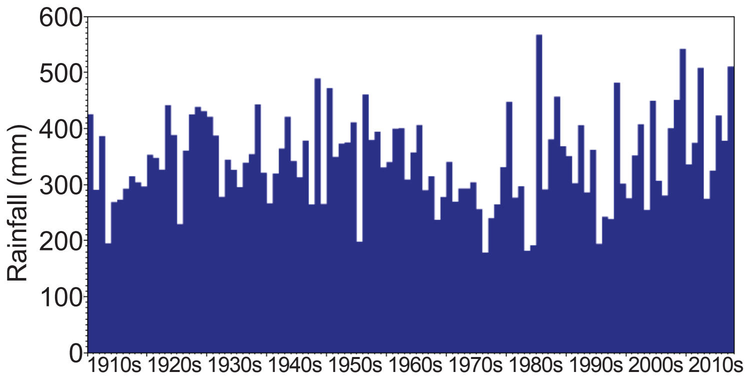
August 2017 rainfall as % of 1981-2010 average



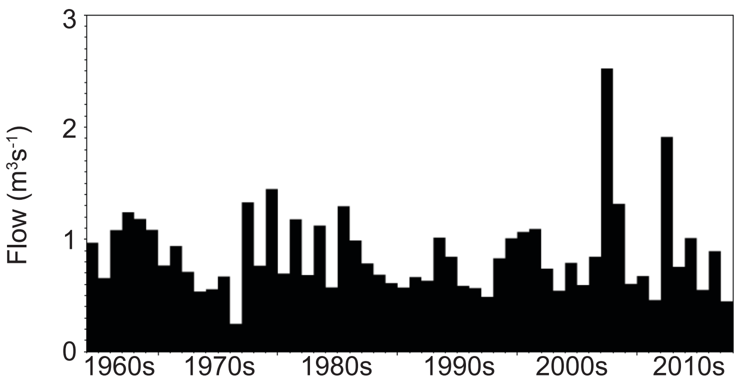
June 2017 - August 2017 rainfall as % of 1981-2010 average



June - August rainfall for Western Scotland



June - August average river flows on the Coln



Hydrological Outlook UK

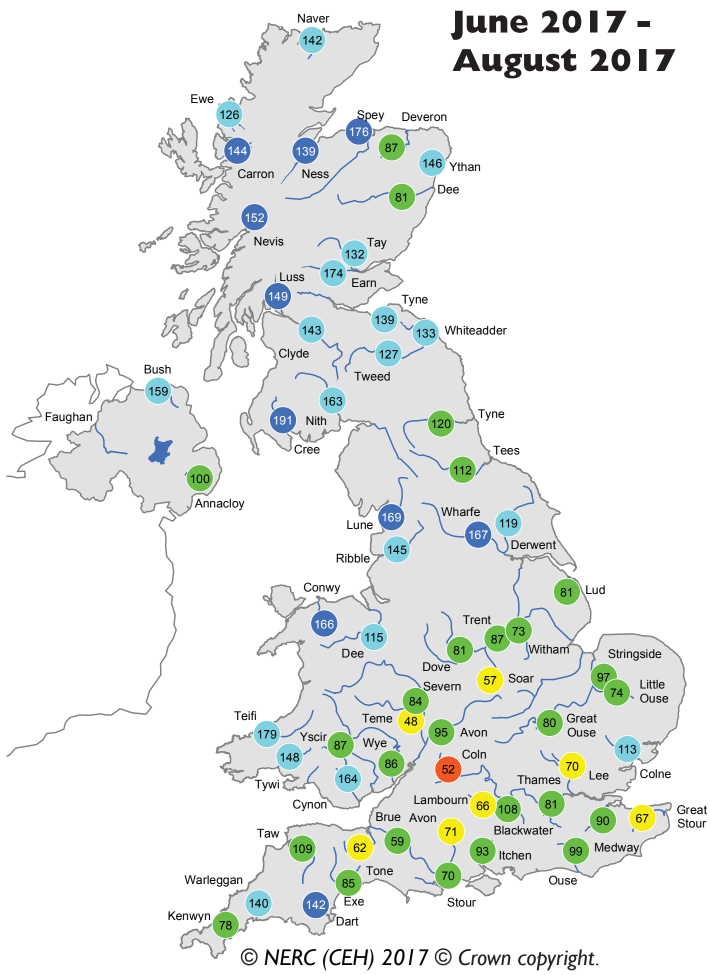
The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

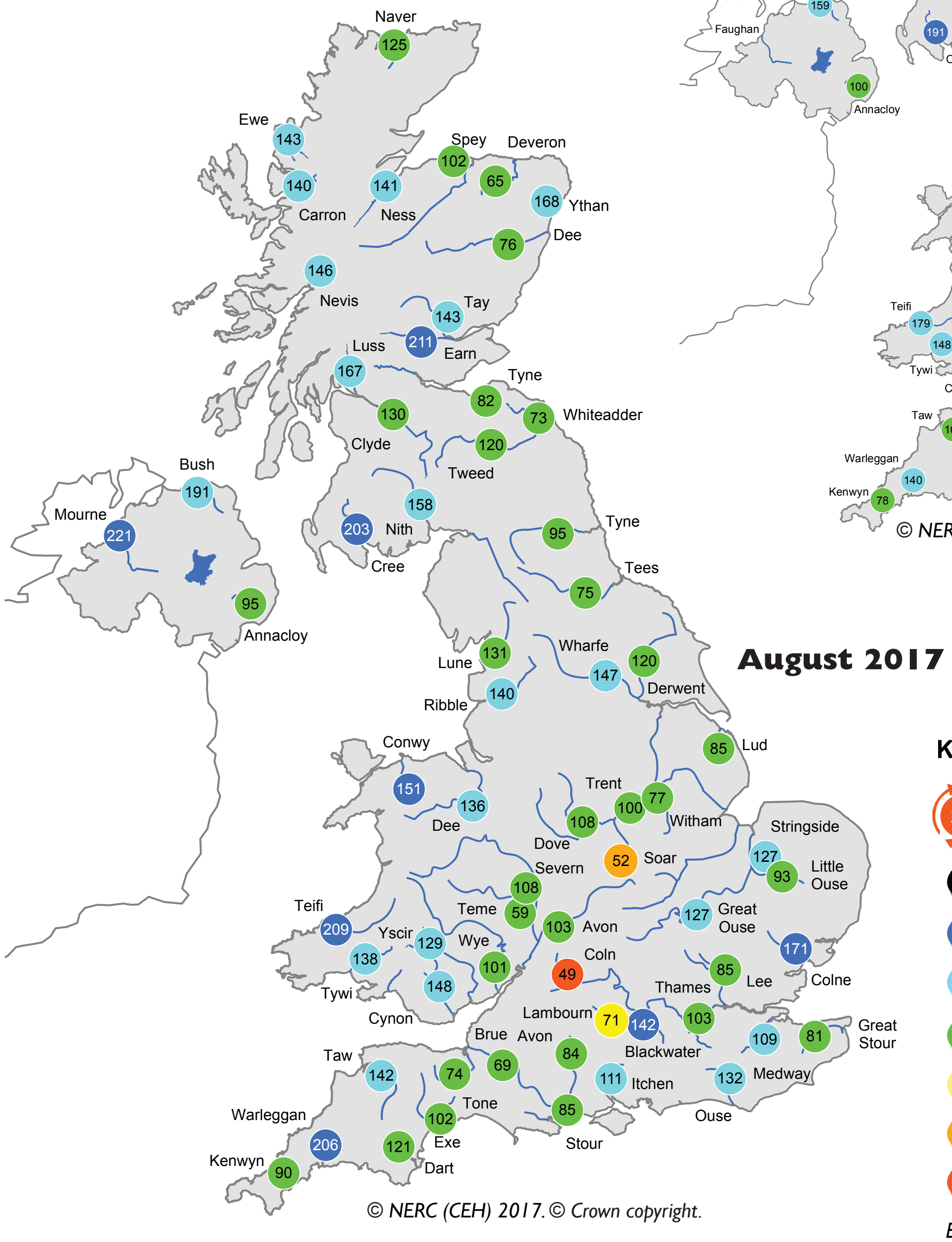
The complete version of the Hydrological Outlook UK can be found at: www.hydoutuk.net/latest-outlook/

Period: **from September2017**
Issued: **13.08.2017**
using data to the end of August 2017

The one month outlook is for river flows to be normal to above normal across the UK, and a similar situation is most likely over the next three months, except in some localised parts of central southern England where flows may be below normal. The one month and three month outlooks for groundwater suggest a continuation of above normal levels in some northern aquifers, and below normal levels in parts of the Chalk of south-east England, suggesting the recharge season will commence from a below normal baseline in some areas.

River flow . . . River flow . . .





Key

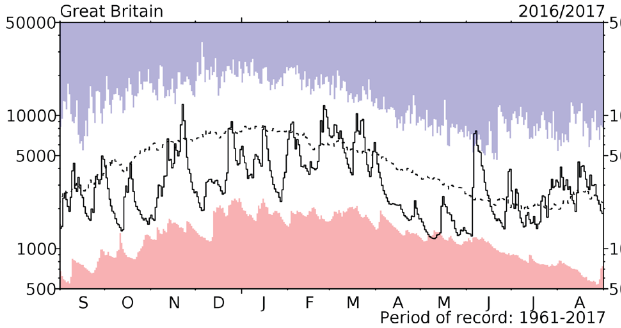
- 25 — % of long-term average (record figure when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

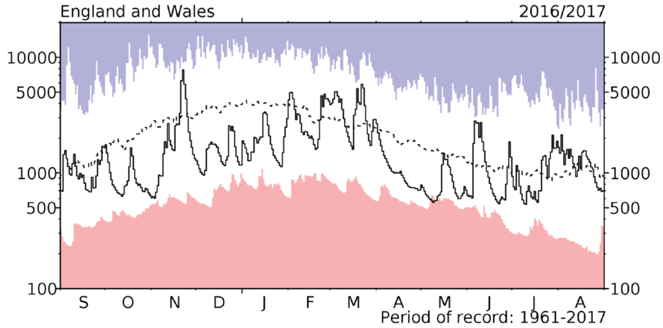
*Based on ranking of the monthly flow**

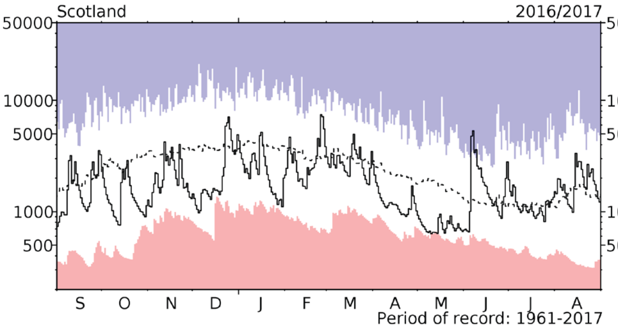
River flows

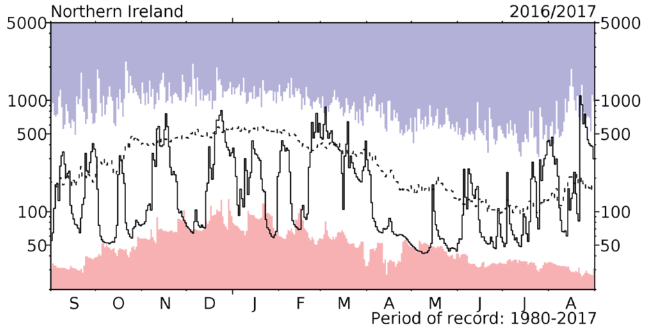
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater. Note: the averaging period on which these percentages are based is 1981-2010. Percentages may be omitted where flows are under review.

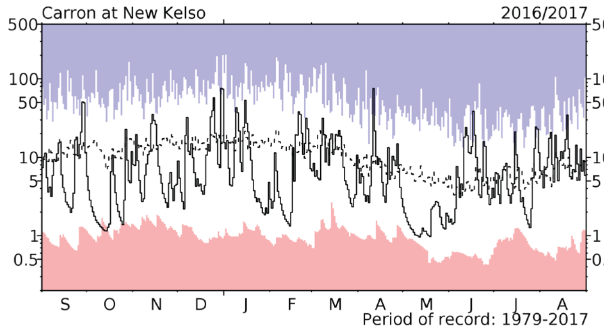
River flow . . . River flow . . .

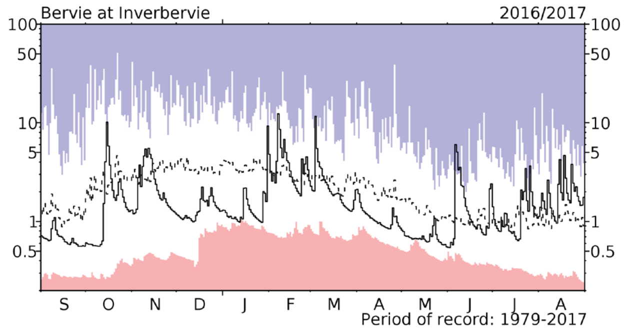


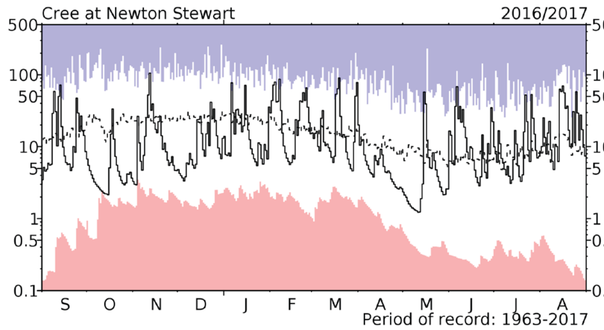


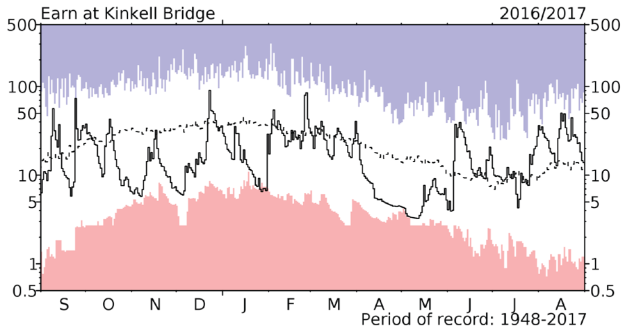


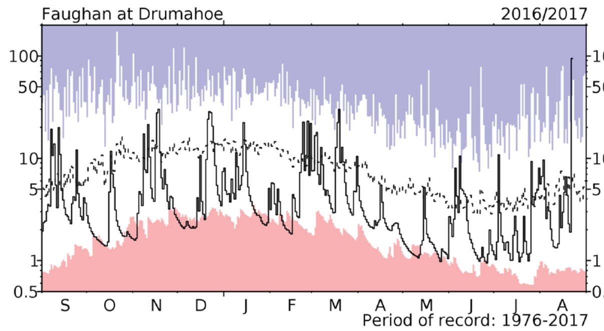


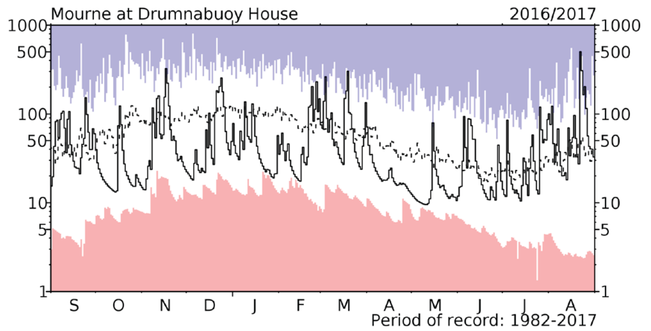








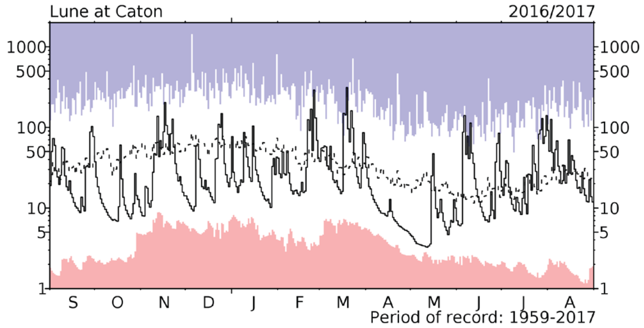


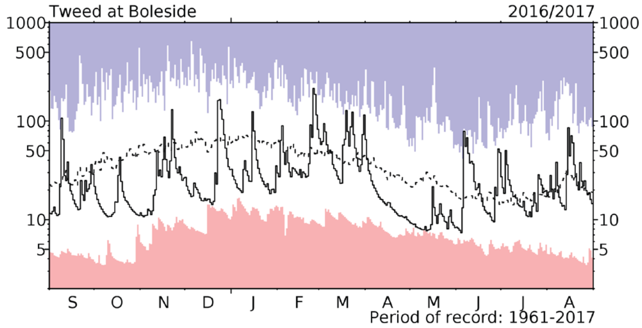


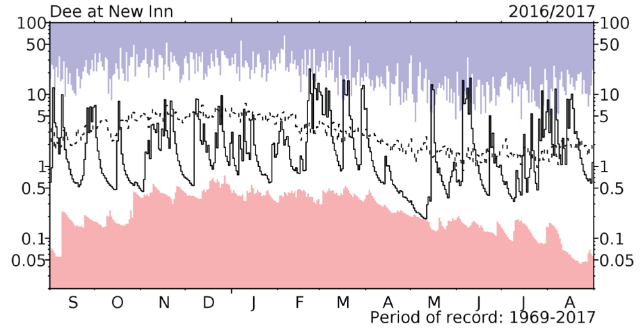
River flow hydrographs

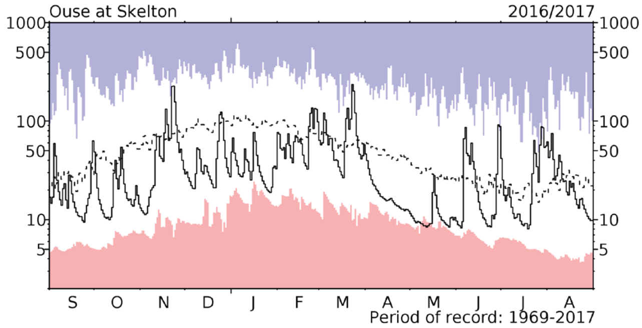
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to September 2016 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed line represents the period-of-record average daily flow.

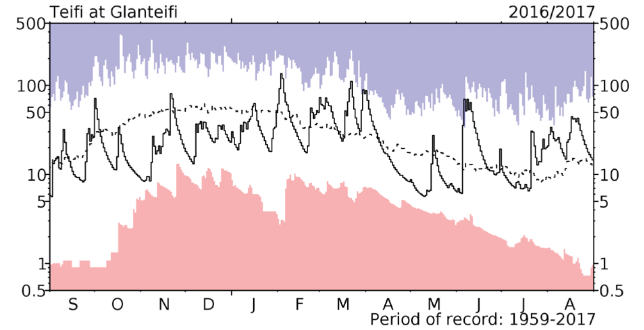
River flow . . . River flow . . .

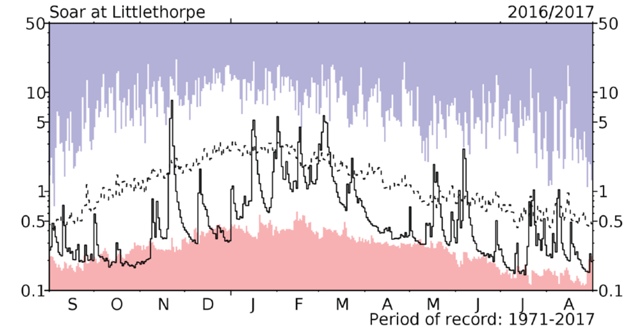


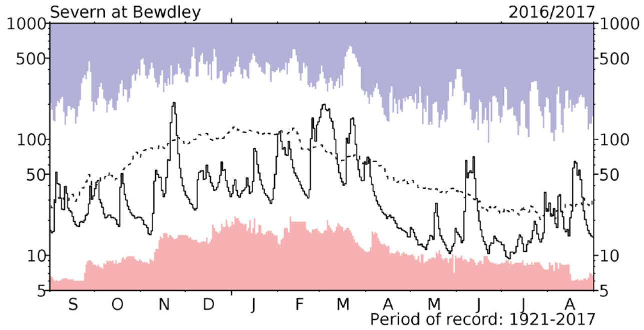


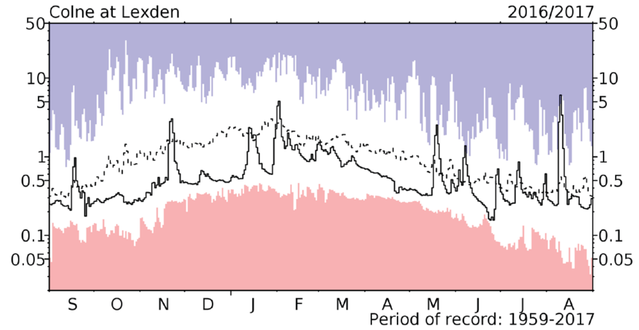


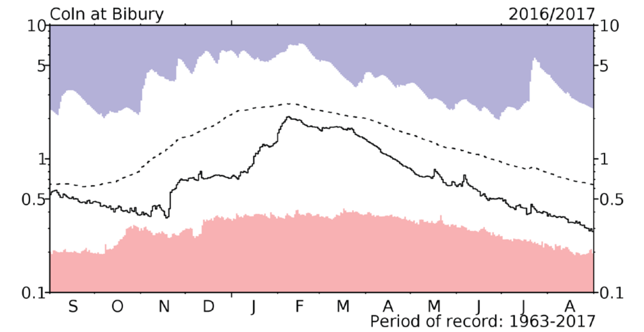


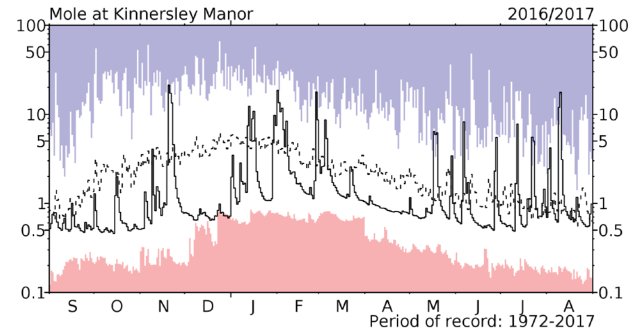


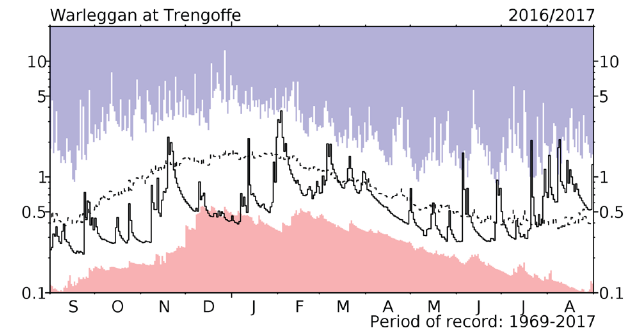


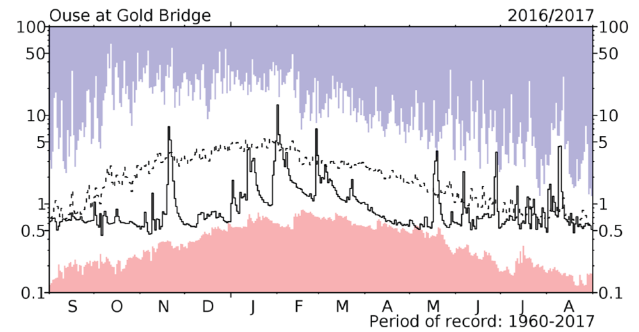




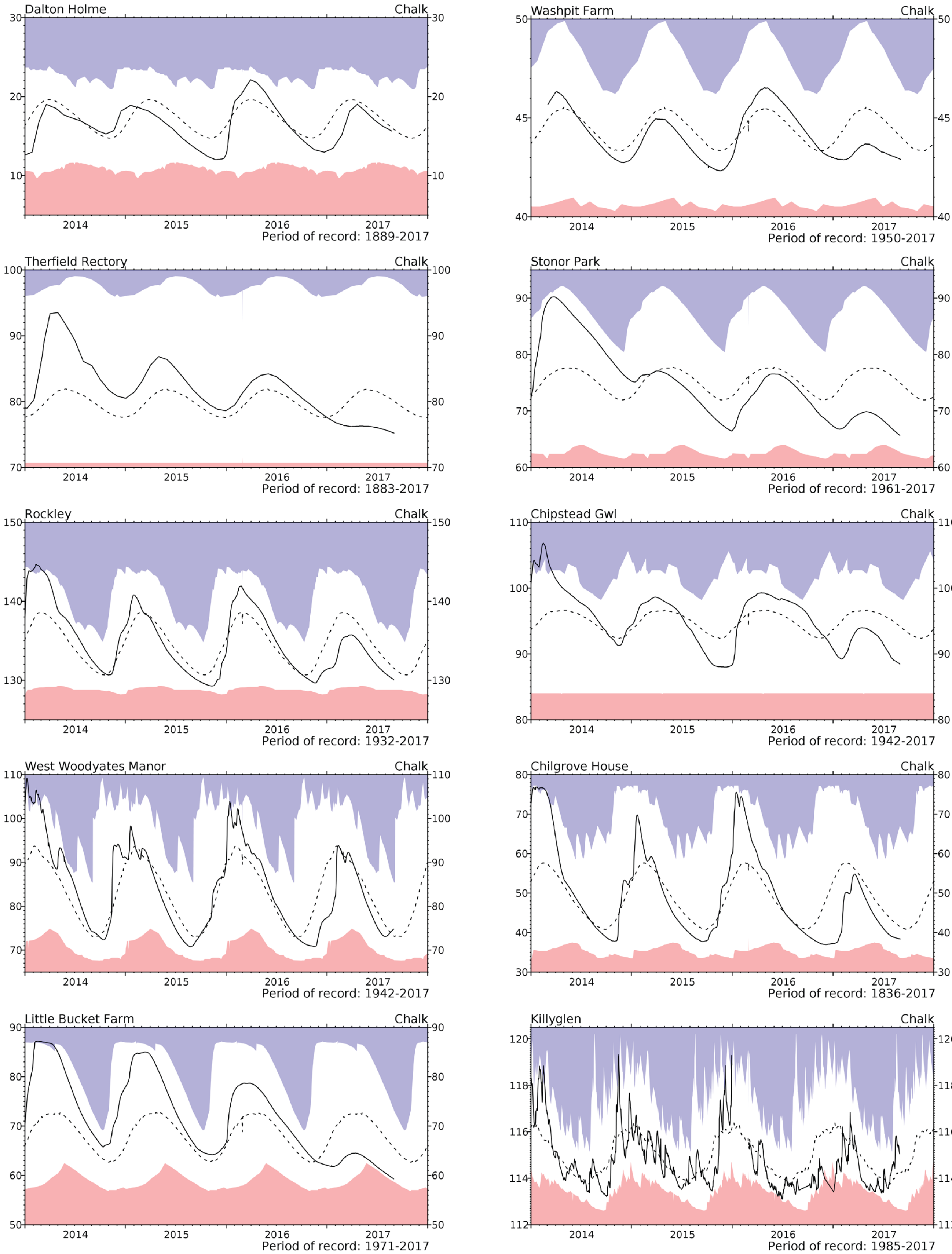




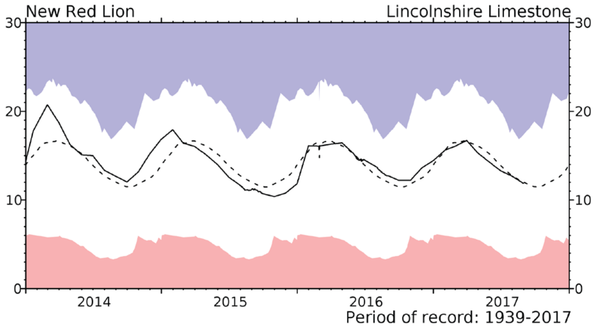


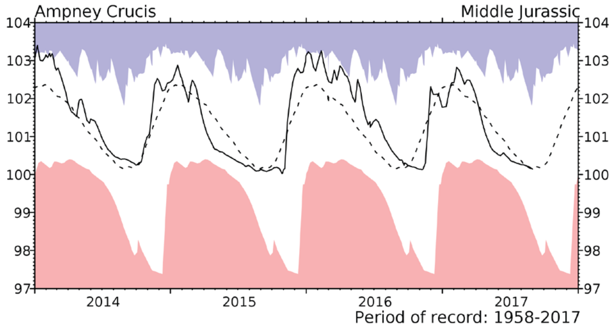


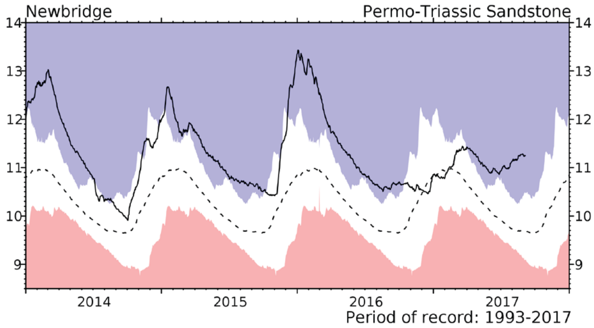
Groundwater . . . Groundwater

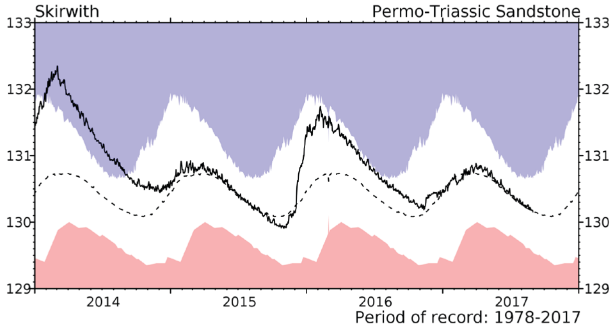


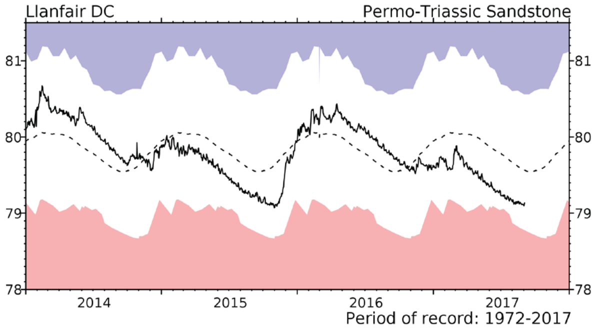
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined below overlying impermeable strata. The monthly mean and the highest and lowest levels recorded for each month are displayed in a similar style to the river flow hydrographs. Note that most groundwater levels are not measured continuously and, for some index wells, the greater frequency of contemporary measurements may, in itself, contribute to an increased range of variation.

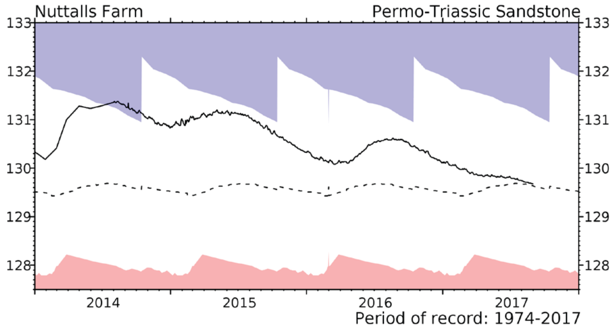

New Red Lion
Lincolnshire Limestone
2014
2015
2016
2017
Period of record: 1939-2017

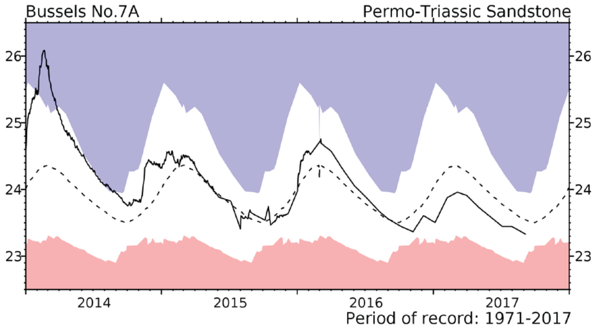

Ampney Crucis
Middle Jurassic
2014
2015
2016
2017
Period of record: 1958-2017

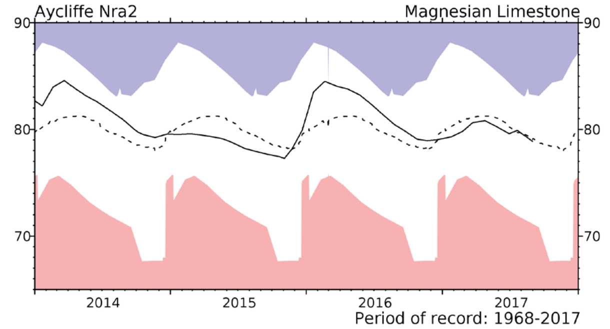

Newbridge
Permo-Triassic Sandstone
2014
2015
2016
2017
Period of record: 1993-2017

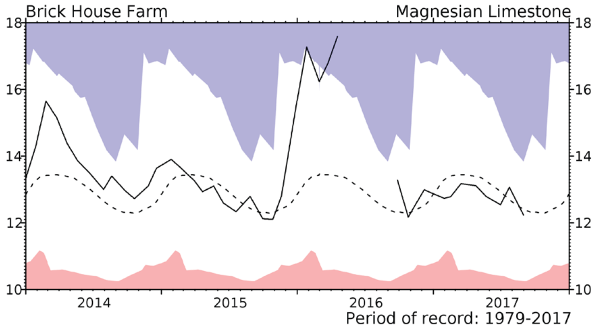

Skirwith
Permo-Triassic Sandstone
2014
2015
2016
2017
Period of record: 1978-2017

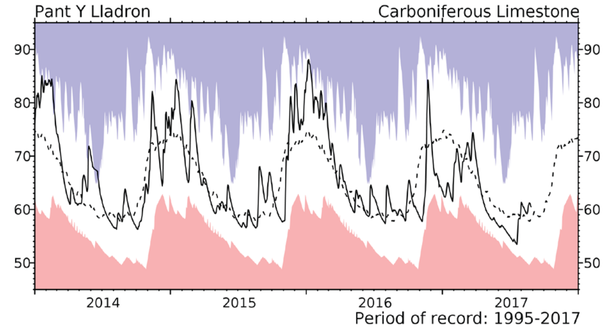

Llanfair DC
Permo-Triassic Sandstone
2014
2015
2016
2017
Period of record: 1972-2017

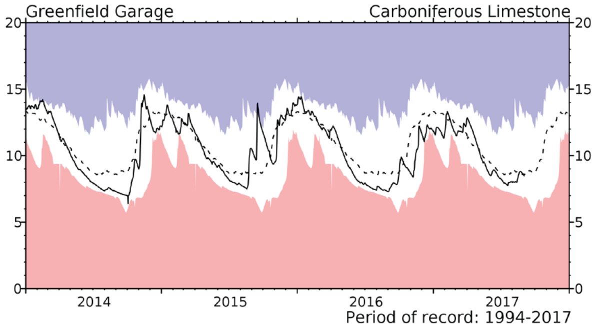

Nuttalls Farm
Permo-Triassic Sandstone
2014
2015
2016
2017
Period of record: 1974-2017

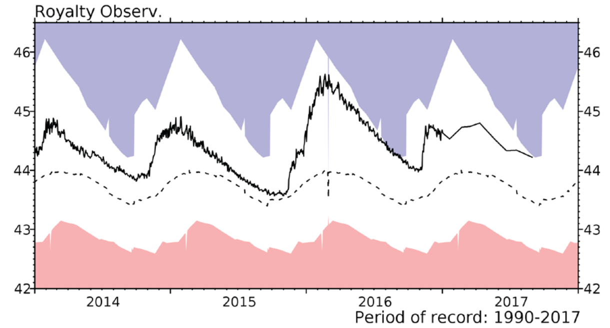

Bussels No.7A
Permo-Triassic Sandstone
2014
2015
2016
2017
Period of record: 1971-2017


Aycliffe Nra2
Magnesian Limestone
2014
2015
2016
2017
Period of record: 1968-2017

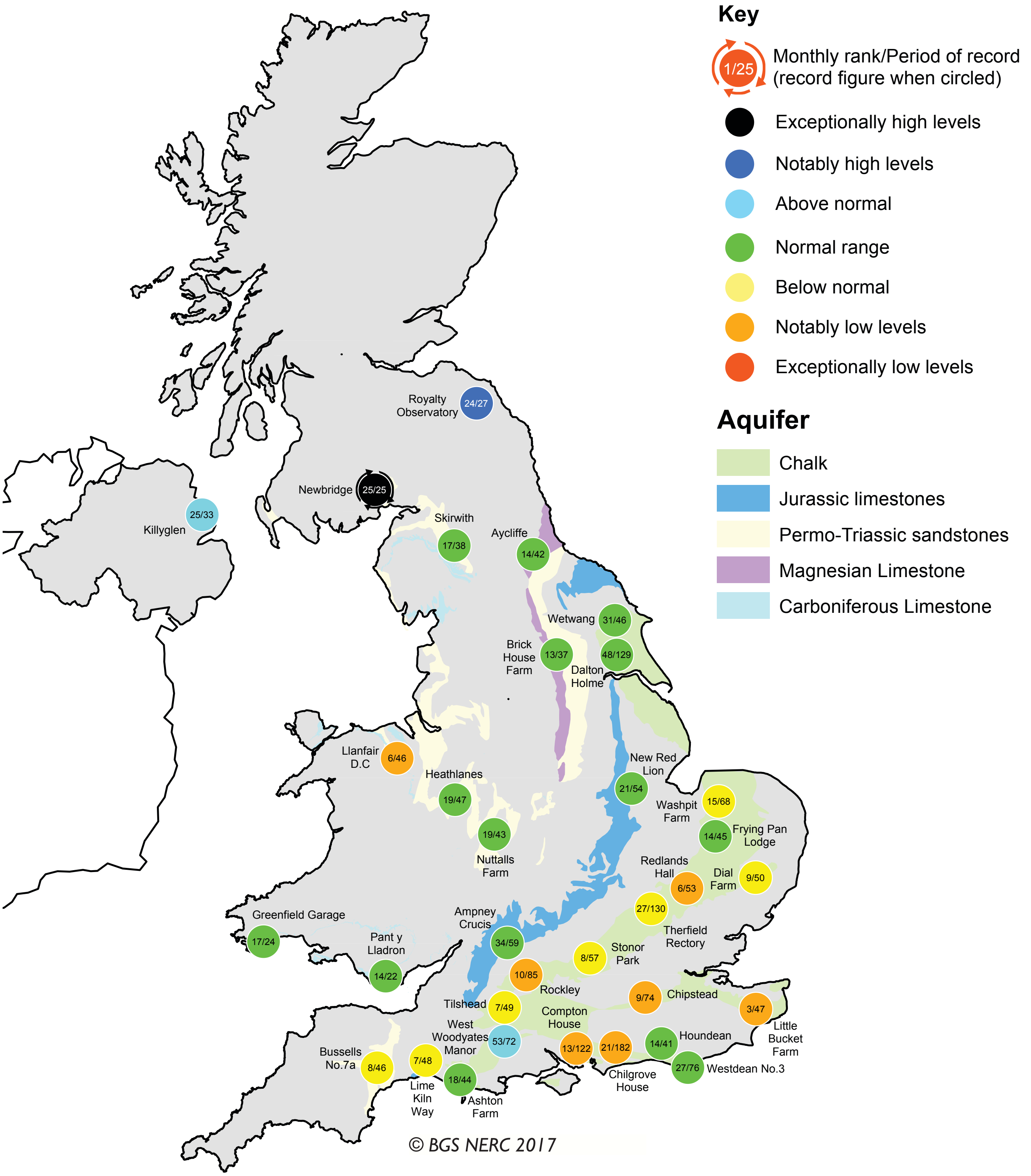

Brick House Farm
Magnesian Limestone
2014
2015
2016
2017
Period of record: 1979-2017


Pant Y Lladron
Carboniferous Limestone
2014
2015
2016
2017
Period of record: 1995-2017


Greenfield Garage
Carboniferous Limestone
2014
2015
2016
2017
Period of record: 1994-2017


Royalty Observ.
2014
2015
2016
2017
Period of record: 1990-2017

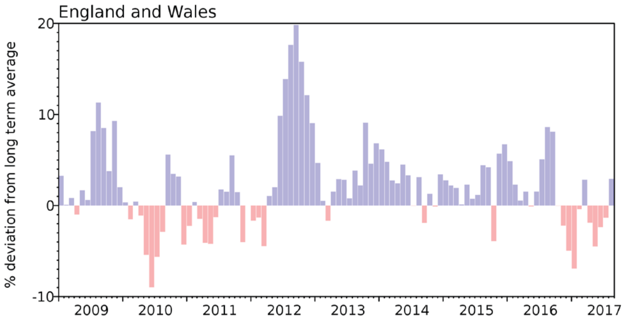
Groundwater...Groundwater



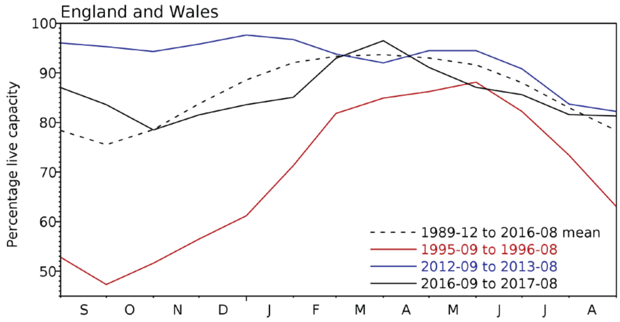
Groundwater levels - August 2017

The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. The rankings are designed as a qualitative indicator, and ranks at extreme levels, and when levels are changing rapidly, need to be interpreted with caution.

Guide to the variation in overall reservoir stocks for England and Wales



Comparison between overall reservoir stocks for England and Wales in recent years



Percentage live capacity of selected reservoirs at end of month

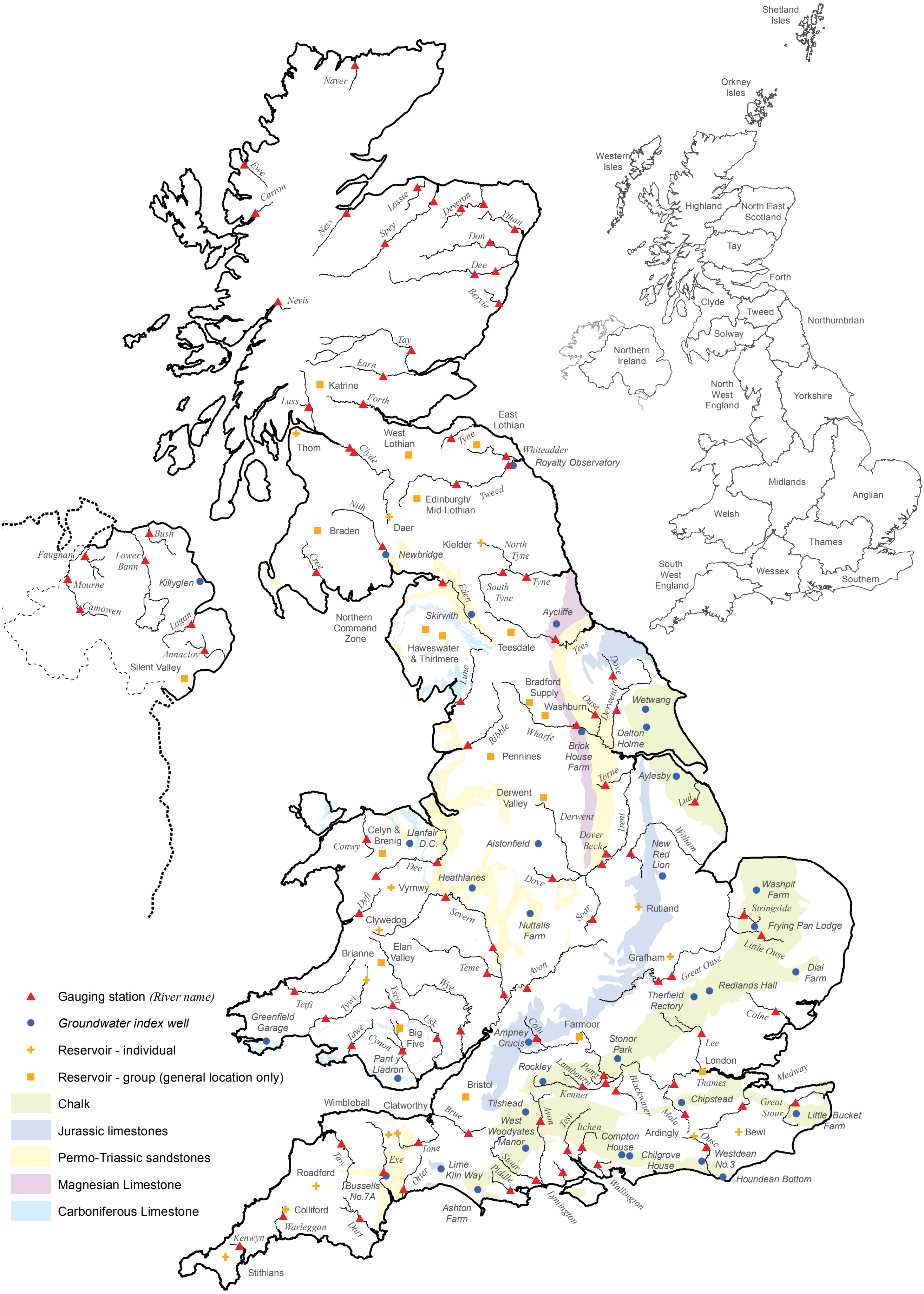
Area	Reservoir		Capacity (Ml)	2017 Jun	2017 Jul	2017 Aug	Aug Anom.	Min Aug	Year* of min	2016 Aug	Diff 17-16
North West	N Command Zone	•	124929	78	72	72	13	15	1984	72	0
	Vyrnwy		55146	95	93	97	26	36	1995	98	-1
Northumbrian	Teesdale	•	87936	76	81	85	13	38	1995	88	-3
	Kielder		(199175)	92	89	87	-1	66	1989	96	-8
Severn-Trent	Clywedog		44922	96	82	93	15	27	1976	98	-6
	Derwent Valley	•	39525	76	66	61	-6	34	1995	90	-28
Yorkshire	Washburn	•	22035	80	80	77	7	34	1995	68	9
	Bradford Supply	•	41407	74	72	73	5	21	1995	75	-2
Anglian	Grafham		(55490)	94	94	96	9	59	1997	91	5
	Rutland		(116580)	93	91	91	9	66	1995	90	1
Thames	London	•	202828	89	82	80	-2	62	1995	84	-4
	Farmoor	•	13822	94	99	91	-3	64	1995	97	-7
Southern	Bewl		28170	62	56	50	-20	38	1990	81	-31
	Ardingly		4685	91	84	84	10	47	1996	80	4
Wessex	Clatworthy		5364	75	65	68	3	31	1995	53	15
	Bristol	•	(38666)	81	72	64	-5	43	1990	71	-7
South West	Colliford		28540	77	74	76	4	43	1997	76	1
	Roadford		34500	70	67	68	-5	40	1995	77	-9
	Wimbleball		21320	74	63	59	-11	40	1995	60	-1
	Stithians		4967	83	76	73	11	30	1990	61	12
Welsh	Celyn & Brenig	•	131155	88	88	89	6	49	1989	99	-10
	Brianne		62140	98	97	99	11	55	1995	99	0
	Big Five	•	69762	85	81	78	5	29	1995	85	-7
	Elan Valley	•	99106	79	68	68	-9	37	1976	86	-18
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	85	82	84	5	45	1998	86	-2
	East Lothian	•	9374	100	100	98	13	63	1989	96	2
Scotland(W)	Loch Katrine	•	110326	84	83	94	22	50	2000	79	15
	Daer		22412	80	78	87	9	41	1995	86	1
	Loch Thom		10798	74	71	81	-3	58	1997	100	-19
Northern Ireland	Total+	•	56800	83	84	88	12	40	1995	77	11
	Silent Valley	•	20634	81	82	87	15	33	2000	75	12

( ) figures in parentheses relate to gross storage • denotes reservoir groups *last occurrence

+ excludes Lough Neagh

Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2012 period except for West of Scotland and Northern Ireland where data commence in the mid-1990s. In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes. Monthly figures may be artificially low due to routine maintenance or turbidity effects in feeder rivers.

Location map…Location map



NHMP

The National Hydrological Monitoring Programme (NHMP) was started in 1988 and is undertaken jointly by the Centre for Ecology & Hydrology (CEH) and the British Geological Survey (BGS). The NHMP aims to provide an authoritative voice on hydrological conditions throughout the UK, to place them in a historical context and, over time, identify and interpret any emerging hydrological trends. Hydrological analysis and interpretation within the Programme is based on the data holdings of the National River Flow Archive (NRFA; maintained by CEH) and National Groundwater Level Archive (NGLA; maintained by BGS), including rainfall, river flows, borehole levels, and reservoir stocks.

Data Sources

The NHMP depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged. River flow and groundwater level data are provided by the Environment Agency (EA), Natural Resources Wales - Cyfoeth Naturiol Cymru (NRW), the Scottish Environment Protection Agency (SEPA) and, for Northern Ireland, the Rivers Agency and the Northern Ireland Environment Agency. In all cases the data are subject to revision following validation (high flow and low flow data in particular may be subject to significant revision).

Details of reservoir stocks are provided by the Water Service Companies, the EA, Scottish Water and Northern Ireland Water.

The Hydrological Summary and other NHMP outputs may also refer to and/or map soil moisture data for the UK. These data are provided by the Meteorological Office Rainfall and Evaporation Calculation System (MORECS). MORECS provides estimates of monthly soil moisture deficit in the form of averages over 40 x 40 km grid squares over Great Britain and Northern Ireland. The monthly time series of data extends back to 1961.

Rainfall data are provided by the Met Office. To allow better spatial differentiation the rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA, NRW and SEPA. The areal rainfall figures have been produced by the Met Office National Climate Information Centre (NCIC), and are based on 5km resolution gridded data from rain gauges. The majority of the full rain gauge network across the UK is operated by the EA, NRW, SEPA and Northern Ireland Water; supplementary rain gauges are operated by the Met Office. The Met Office NCIC monthly rainfall series extend back to 1910 and form the official source of UK areal rainfall statistics which have been adopted by the NHMP. The gridding technique used is described in Perry MC and Hollis DM (2005) available at
http://www.metoffice.gov.uk/climate/uk/about/methods

Long-term averages are based on the period 1981-2010 and are derived from the monthly areal series.

The regional figures for the current month in the hydrological summaries are based on a limited rain gauge network so these (and the associated return periods) should be regarded as a guide only.

The monthly rainfall figures are provided by the Met Office NCIC and are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation.

For further details on rainfall or MORECS data, please contact the Met Office:

Tel: 0870 900 0100
Email: enquiries@metoffice.gov.uk

Enquiries

Enquiries should be directed to the NHMP:

Tel: 01491 692599
Email: nhmp@ceh.ac.uk

A full catalogue of past Hydrological Summaries can be accessed and downloaded at:

http://nrfa.ceh.ac.uk/monthly-hydrological-summary-uk

09/2017

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